## REMARKS

Claims 1, 3 – 7, and 9 – 15 are currently pending. Claims 2 and 8 have been canceled and rewritten in independent form as claims 1 and 7, respectively. The amendment of claims 1, 2, 7, and 8 resulted in the necessity to amend the remaining claims in order to correct their dependency and the antecedent basis for some terms. Support for new claim 13 can be found in the present specification on page 8, line 16. Support for new claim 14 and 15 can be found on page 9, lines 6 – 7. Therefore, no new matter has been introduced by the amendment.

The Examiner has rejected claims 1 and 3 – 6 under 35 U.S.C. § 102(e), claims 7, 8, and 11 under 35 U.S.C. § 102(b), and claims 2 – 6 and 9 – 12 under 35 U.S.C. § 103(a). Applicants respectfully traverse the Examiner's rejections and request reconsideration and withdrawal of the rejections based on the following remarks.

*Rejection of Claims 1 and 3 – 6 under 35 U.S.C. § 102(e)*

The examiner rejects claims 1 and 3 – 6 under 35 U.S.C. § 102(e) as being anticipated by U.S. Patent 6,562,204 to Mayer et al. ("Mayer") and asserts that Mayer discloses every element of Applicant's invention. Applicants respectfully disagree.

Claim 1 as currently amended claims a device comprising an anode, a cathode, a first and second reference electrode, and a voltmeter provided between each of the anode, cathode, and first and second reference electrode. Claims 3 – 6 depend from claim 1 and incorporate these elements as well. In Figure 1 and column 5, lines 7 – 11 of Mayer, the apparatus for potential controlled electroplating of fine pattern on semiconductor wafers comprises a semiconductor wafer and an anode and a reference electrode, which is used to monitor and control the potential of the electrolyte solution with respect to the surface of the wafer. Thus, Mayer's apparatus fails to include a second electrode or a means of measuring the voltage drop between the reference electrodes and the anode as required by claim 1.

Therefore, Mayer fails to anticipate Applicants' invention because Mayer fails to explicitly disclose every element of the invention. Reconsideration and withdrawal of the rejection under 35 U.S.C. § 102(e) is respectfully requested.

*Rejection of Claims 7, 8, and 11 under 35 U.S.C. § 102(b)*

The examiner rejects claims 7, 8, and 11 under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent 4,834,842 to Langner et al. ("Langner") and asserts that Langner discloses every element of Applicant's invention. Applicants respectfully disagree.

Claim 7 as currently amended claims a method of monitoring an electrolytic process in an electrolytic cell comprising directly measuring the electric voltages with a voltmeter between an anode, cathode, and first and second reference electrode. Claim 11 depends from claim 7 and incorporates these elements as well.

Langner does not include reference electrodes and therefore, cannot measure the voltage between the anode, cathode, and reference electrodes. In column 4, lines 25-26, Langner explicitly states that reference electrodes are not required in the disclosed method of measuring the effective inhibitor concentration during deposition of metal in an electrolyte. Therefore, Langner lacks that element of reference electrodes. The Examiner asserts that the wires 6b and 6c are reference electrodes, despite Langner's statement to the contrary; however, even if the Examiner's assertion is accepted, Langner does not directly measure the voltage between wires 6b and 6c with a voltmeter. Referring to Figure 1 of Langner, the diagrammatic depiction of the measuring cell fails to include an additional voltmeter in order to directly measure the voltage across the electrolyte. Langner uses an anode voltmeter and a cathode voltmeter and an algebraic equation along with several assumptions about the system to approximate the voltage between the two wires labeled 6b and 6c by using a computer. The objective of Langner is to determine the cathode potential over time in order to predict the effectiveness of the inhibitor in the electrolyte. This is achieved by taking only the two measurements depicted in Figure 1. Referring to column 4, lines 27 – 40, because the wires 6a – 6d are spaced equally apart, the only voltages that must be measured are U1 and U3 which correspond to the anode voltmeter and the cathode voltmeter. Because U-Total, the voltage applied to the system, is a known value, the

computer can calculate U2 by subtracting the sum of U1 and U3 from U-Total. Once U2 is calculated, the computer can then calculate the cathode potential, KP, by subtracting the calculated value of U2 from the measured value U1 which was measured by using the cathode voltmeter. The assumptions which make this calculation possible are that the wires are spaced exactly equidistant and that the electrolyte is well-mixed with uniform properties across the system, resulting in the need for no more than the two voltmeters demonstrated in Figure 1.

Langner does not have the element of a voltmeter directly measuring the voltage between two reference electrodes. Therefore, Langner fails to anticipate Applicants' invention. Reconsideration and withdrawal of the rejection under 35 U.S.C. § 102(b) is respectfully requested.

*Rejection of Claims 2 – 6 and 9 – 12 under 35 U.S.C. § 103(a)*

The Examiner rejects claims 2 – 6 and 9 – 12 under 35 U.S.C. § 103(a) and asserts that the combination of Mayer and Langner discloses all of the elements of Applicants' invention and that from the combination of the references, Applicants' device would have been obvious to a person having ordinary skill in the art at the time of Applicants' invention. The Examiner further asserts that a person of ordinary skill in the art would have combined the references in order to determine the electric voltage between the electrodes so as to ensure a high and uniform quality of the metal deposit and to use capillary chambers to prevent the cross contamination between electroplating solution in the cell and the reference electrode by the diffusion of ions. Applicants respectfully disagree.

The Examiner admits that Mayer does not teach a second reference electrode and voltmeters to measure the voltage between an anode, cathode, and first and second reference electrodes. Because Mayer lacks a second reference electrode, the apparatus disclosed by Mayer cannot achieve the same objective of Applicants' invention, to reliably detect and accordingly prevent metal defects (voids) to form in the deposited structures at a semiconductor wafer by directly measuring the voltage at the cathode, anode, or in the electrolyte solution, refer to Applicants current specification page 14, line 25 to page 15 line 24.

To reliably detect and prevent such defects from forming will require sensing the potential both at the surface of the semiconductor wafer and at the surface of the anode, since defects being formed may be due to problems inherent in the anode working. Thus, if such problems arise in the electrolytic cell, Mayer would not be aware of the problems because the voltmeter could not detect any potential deviation from normal behavior which occurs at the anode and which would lead to such problems. Mayer might only detect defects originating from problems associated with the semiconductor itself in that the potential at the wafer is sensed. Further, Mayer would not be able to detect any problems associated with the electrolyte, because Mayer does not provide measuring the potential drop inside the electrolyte between the semiconductor wafer and the anode.

The Examiner asserts that the deficiencies in Mayer's apparatus can be overcome by its combination with Langner; however Langner also does not teach all of the elements of Applicants' invention and specifically teaches away from its combination with Mayer.

As previously discussed, Langner explicitly discloses that reference electrodes are unnecessary. Langner's method aims at providing for the measurement of the effective concentration of inhibitors in electrolytes for the electrodeposition of metals (col. 2, lines 34-38) and accomplishes this method without reference electrodes, but rather with simple wires. Langner's apparatus constantly provides fresh conductor surface by the use of winding means 4 and 5 (Figure 1 and column 4, lines 3 – 8 of Langner). This is necessary because many factors can affect the potential of the wires, such as the metal ion concentration and additive concentration as well as additive type in the deposition bath, and make it difficult to determine the cause of abnormal electrolytic deposition. Applicants eliminate the influence of such factors on the potential measurements by using reference electrodes. Because Mayer uses reference electrodes and Langner explicitly teaches away from their use by replacing them with simple wires and a means of providing fresh conductor surface, a person of ordinary skill in the art would not combine the references.

Langner also teaches away from the placement of reference electrodes at the surface of the anode and cathode. Mayer teaches an apparatus having an electrode placed near the surface

to be electro-plated. It is critical that the metal wires 6a - 6d of the Langner apparatus are spaced, such that they are equidistant between each pair of adjacent metal wires (Fig. 1, col. 4, lines 15-19). The voltmeters do not measure the voltage at the anode and cathode, but rather the sum of such potential and the potential drop caused by the electrolyte resistivity (for example, the voltage drop between metal wires 6a and 6b is reported to be KP +1/3U-electrolyte, wherein KP is the cathode potential in millivolts and U-electrolyte is the voltage drop across the electrolyte, Fig. 2 and col. 4, lines 9-31). If the wires taught by Langner were not equidistant, the calculations of the computer based on Langner's equation would be incorrect. Therefore, a person having ordinary skill in the art would not combine Langner with Mayer which requires that a reference electrode be placed near the surface to be plated.

Also, as previously discussed, neither Langner, nor Mayer, disclose the element of a voltmeter directly measuring the voltage between two reference electrodes. Mayer only discloses one reference electrode and Langner discloses wires, not electrodes, in which the voltage between the two middles wires, 6b and 6c, are not measured directly. Langner assumes that the potential in the electrolyte is constant and directly proportional to the distance between the wires. Langner's method of calculating the potential rather than directly measuring the potential would not result in accurate values. In real systems, simplification based on assumptions on the resistivity of the electrolyte solution is not possible and therefore measurement "at the surface of the at least one anode" and "at the surface of the at least one cathode" and "between two reference electrodes" will be mandatory to achieve the required result of Applicants' invention.

Therefore, upon examination of the teachings of the references, the combination of Langner and Mayer would not suggest to a person having ordinary skill in the art at the time of Applicants' invention that the invention was obvious. Applicants respectfully request reconsideration and withdrawal of the rejections under 35 U.S.C. § 103(a).

## CONCLUSION

In view of the foregoing amendments and remarks, Applicants submit that the claims presented herewith are patentable over the prior art of record and in condition for allowance. Applicants respectfully solicit prompt action thereon. If any questions remain, the Examiner is invited to phone the undersigned attorney.

Respectfully submitted,

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